ASSESSMENT OF OIL AND OTHER CONTAMINANTS IN THE LOWER PORTION OF TALFORD CREEK

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Ministry of the Environment
Ontario

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INTRODUCTION

A water and sediment quality survey was conducted on August 7-9, 1973, in Talford Creek. The study was initiated in response to a request by the Industrial Wastes Branch resulting from complaints received by the Sarnia office that floating oil mats were sighted in the St. Clair River immediately downstream of the mouth of Talford Creek and these mats did not appear to be associated with possible sources upstream on the St. Clair River. It was also intended to expand on earlier observations by Water Quality Branch survey crews of oil accumulations in the sediments of the lower creek.

In addition to the August survey, further field sampling was carried out on January 29 and 30, 1974, to assess the condition of the bottom fauna in the stream and to investigate the possibility that contaminants are being brought into the creek by the intrusion of St. Clair River water.

1. SUMMARY OF FINDINGS AND RECOMMENDATIONS

1.1 Summary of Findings

The reported sightings of oil mats in the St. Clair River downstream of Talford Creek were not confirmed during surveys in either August 1973 or January 1974. If in fact these mats did originate from Talford Creek and not from upstream industry on the St. Clair River, accumulations of oil in sediments and on the banks of Talford Creek below Shell Canada Limited (when considered with the reported discharges of oil by the company and the absence of other known sources of oily wastes to the creek) would strongly suggest that this company's operations were the source.

The oil may have resulted from spills of heavy oil from Shell or alternatively may be mats of relatively buoyant surface sediments high in oil content which had been forced to the water's surface by gas accumulations produced during decay of organic matter in the creek sediments.

In addition, to the visible occurrence of oil in the creek sediments below Shell, which is also reflected in the high ether soluble levels, accumulations of other contaminants were also found in this reach of Talford Creek. The most significant of these were increased PCB and lead levels, the former being two orders of magnitude and the latter six times greater below than above the company's outfalls. No data were available on past discharges (if any) of these contaminants by Shell, however, the similarity of their distribution in the sediments with that of ether solubles indicates a possible association with Shell effluents.

Temperature profiling as well as field observations of water movement in Talford Creek show that strong backeddying occurs in the vicinity of, and downstream of Shell's outfalls. This is felt to contribute to the deposition of contaminants in the lower portion of the creek.

Intrusion of St. Clair River water into Talford Creek was observed during the August 1973 survey, however, it was limited to a distance of about 60 feet upstream of the mouth and is considered an extreme case. It is, therefore, felt that contaminants found in the creek sediments have not been brought into the creek by intrusion of river water.

An examination of benthic fauna in the creek in January 1974 revealed the presence of only two species, both sludgeworms which are known to be pollution tolerant forms. Moderately high numbers of these organisms were found near the mouth while numbers decreased progressively at stations nearer the Shell outfalls reflecting higher toxicities and/or scouring by the effluent. Upstream of the Shell discharges the sludgeworm population was even smaller likely as a result of very low water temperatures, i.e. about 1°C and limited availability of suitable substrate.

1.2 Recommendations

Shell Canada Limited continue to improve abatement programs for the reduction in the discharge of oils to Talford Creek.

The Shell effluent be monitored for lead and PCB and strict controls initiated on discharges of these substances, if they are found to be present.

Concurrent with waste stream abatement programs and in keeping with the Ministry policy for the enhancement of water quality, the company undertake the rehabilitation of the existing creek bed between its outfalls and the mouth by removing the contaminated sediments for controlled on-land disposal.

Consideration be given to removing both process and cooling water discharges from Talford Creek in favour of a discharge to the St. Clair River to provide more rapid assimilation of residual organics and waste heat.

2. DESCRIPTION OF STUDY AREA

Talford Creek is a small tributary of the St. Clair River having an overall length of about 8 miles and a drainage area of some 24 square miles. The primary function of this watercourse at present, is one of a waste receiver for effluents from Dow Chemical Canada Limited and Shell Canada Limited and for numerous domestic septic tank discharges. The former company operates waste brine lagoons located about 3½ miles upstream of the mouth which contribute minimal flow to the creek, but which have been implicated in the occurrence of high mercury levels in the creek sediments. Shell discharges process wastewater, stormwater and cooling water through two outfalls at a point approximately 960 feet upstream of the mouth. The dry weather flow at the mouth of the creek, is for the most part, attributable to discharge flows of Shell which average 60 MGD.

As the Shell wastewaters are the only known continuous source of oily waste input to Talford Creek, the study was restricted to the area downstream of the company with appropriate upstream control sampling.

3. FIELD PROCEDURES

During the August survey, 9 cross-sections along a 2000 foot stretch of Talford Creek were selected for sampling (see Figure 1). The upper most section was located 1000 feet upstream of the Shell outfall area and the lower most cross-section was located at the Highway 40 bridge over Talford Creek (900 feet downstream of the outfalls and 60 feet from the mouth). The downstream outfall carries cooling water, while the upstream outfall carries treated process wastewater and storm drainage. These outfalls are designated A and B respectively in the accompanying graphs.

Bottom sediment samples were collected from the middle point and within 10 feet of each shore at 9 cross-sections on August 8-9, 1973. A hand coring apparatus was used to obtain all sediment samples. The top 4 inches of each core sample was submitted to the Ministry's Toronto laboratory for analysis of cadmium, zinc, lead, total mercury, COD, BOD, percent loss on ignition, ether solubles and PCB's. In addition to sediment sampling, surface water samples were taken for on-location analysis of temperature, pH and dissolved oxygen.

In January 1974, a survey crew returned to Talford Creek to collect benthic fauna samples and undertake detailed temperature profiling at a number of cross-sections above and below Shell. The benthic samples were obtained near each shore using a Ponar dredge and returned to the Ministry's London laboratory for screening, identification and enumeration. Temperature profiling was done using a telethermometer on a grid of 10 feet width and 1 foot depth at each cross-section.

4. DISCUSSION OF RESULTS

4.1 Field Observations

During both surveys, Talford Creek was found to be free of floating oil, however, during the August survey, oil was noted at the waterline along both banks downstream of the outfalls of Shell Canada Limited.

Waters both upstream and downstream of Shell were turbid from suspended sediment which served to mark the creek's discharge as it entered the St. Clair River. The brownish plume extended about 100 feet into the St. Clair River and was noticeable for some 500 feet downstream.

Sediment samples collected near the banks were sandy clay and not visually contaminated while the mid-creek samples for the entire reach of the study area consisted of a black mud mixed with clay or sand. Below the Shell outfalls, these fine grained mid-creek sediments had a slightly fibrous nature and contained a perceivably high amount of oil which was also detectable by its characteristic odour. Traces of oil were also noted in the sediments upstream of Shell.

The occurrence of oil in upstream sediments may be as a result of an unknown past release of oil to one of the small drainage ditches which enter the creek (see Figure 1) or may have resulted from periodic upstream transport of Shell effluents. In support of this latter possibility, the field crew observed that the passage of a tanker in the St. Clair River on January 29 caused a strong surface wave in the creek, noticeable as far as 700 feet upstream of the outfalls, and likely resulted in some upstream transport of Shell's wastewaters. Temperature profiling during the January survey confirms that this flow reversal is in fact only a temporary phenomenon as detailed later in this section.

Apart from the above observations, the August survey included limited field measurements of water temperature, dissolved oxygen and pH in surface waters while the January survey examined temperature of the creek waters in more detail. As a result of a malfunction in the pH meter, the results are not considered reliable and are therefore excluded from this report. Temperature and DO results are shown in Figure 4 for the August survey.

In this survey, water temperatures were lowest (21°C) at the downstream end of the study area, i.e. at the Highway 40 bridge crossing, suggesting intrusion of St. Clair River water for some 60 feet upstream of the creek mouth. The maximum temperatures were found near Shell's outfalls reaching a high of 27.5°C. Higher temperatures existed on the opposite shore to the outfall than on the adjacent shore, indicating the strong lateral movement of the effluent in relation to the direction of flow in the creek itself. This hydraulic discontinuity which results in backeddies in the immediate downstream area is believed to be the significant factor in creating an area of active deposition for sediments being carried by the creek and for settleable contaminants discharged in the Shell wastewaters.

The temperature profiles obtained on January 30 at 6 transects in the creek are shown in Figure 5. Above the outfalls, the creek waters were within the range of 1.05 to 1.3°C with the exception of waters within 5 feet of the Shell side of the creek and at a distance of 100 feet upstream where backeddies carried the warmer effluent upstream. At the transect between the outfalls, the thermal profile revealed that the bottom waters remained much colder than the surface waters indicating that thorough mixing was not occuring at this point. Temperatures here reached as high as 17.7°C compared to a process effluent temperature of 18.3°C and a cooling water discharge of 17.8°C. Total mixing had essentially occurred at a distance 100 feet downstream of the outfalls as the entire cross-section varied within a range of 1.5°C, i.e. 15.7 to 17.2°C. At the mouth of the creek (960 feet downstream) the thermal profile shows no evidence of St. Clair River waters having any effect on the creek waters as the temperatures remained fairly uniform in the cross-section and only some 2°C lower than those immediately downstream of the outfall. This slight decrease in temperature is well within expected evaporative heat losses to the colder air. The St. Clair River water upstream of the creek mouth was at a temperature of 2.7°C, somewhat higher than the headwaters of Talford Creek.

The water surface elevation of the St. Clair River in August 1973 was about 9 inches higher than the level in January 1974 which would account for minor intrusion into Talford Creek being noticed during the earlier survey but not in the latter. In the annual cycle of water levels in the St. Clair River, the highest levels traditionally occur in the July-August period. The observed intrusion which extended to some 60 feet upstream of the mouth is likely an extreme case as St. Clair River levels during August 1973 were about 22 inches higher than mean levels for August over the period of record (1860-1974) and 28 inches higher than mean levels for August over the last 10 years as reported by the Lake Survey Centre, US Department of Commerce.

4.2 Sediment Quality

The results of sediment analyses show a strong tendency for increases in the concentrations of most parameters downstream of Shell as can be seen in Figures 2 and 3. The most significant increases were noted for mercury, lead, ether solubles and PCB.

Previous mercury results from a survey of the creek bed in 1970 are in basic agreement with the levels found during the present survey. The earlier study did however, show mercury concentrations as high as 53 mg/kg in sediments 500 feet upstream of Shell while levels in August 1973 were all less than 10 mg/kg above the outfalls. The elevated levels of mercury in the creek are not considered attributable to Shell but are believed to result from past discharges of mercury from Dow's waste brine lagoons which has settled in upstream sediments and is being progressively transported downstream and depositing near the creek mouth.

PCB levels steadily increased in sediments below Shell to a maximum of 1000 ug/kg two orders of magnitude greater than upstream levels. The average concentration of lead across a range reached a maximum of 130 mg/kg downstream of Shell, a sixfold increase over upstream levels. Similarly, ether solubles measurements which reflect the oil content of the sediments, showed levels of this parameter to be as much as six times higher below Shell than above.

Increase in these latter three parameters in sediments below Shell are not necessarily conclusive evidence that they have originated from Shells' operations; however, the probability that this is the case for ether solubles is borne out in part by records of oil discharges to Talford Creek. During the first seven months of 1973, the company reported average loadings of ether solubles of 2300 lbs/day (980 lbs/day being taken in with intake water from the St. Clair River). The maximum daily loading reported in this period was 6912 lbs.

There are no data available for either lead or PCB in Shell's effluent. While a survey of PCB users in the Province, made earlier by the Ministry, revealed that Shell had not purchased this material, either in its primary form or in a secondary product, the refinery does use lead in its gasoline blending. The observed lead may also reflect the addition to the creek through surface runoff of soil contaminated by atmospheric releases from a neighbouring tetraethyl lead plant.

There is very little information available on the environmental significance of toxic substances in sediments, however, the US Environmental Protection Agency suggested criteria for the evaluation of dredged spoil afford one measure of sediment quality. This agency's guidelines which are intended for the protection of overlying water quality, state that dredged material containing more than 1500 mg/kg ether solubles and 50 mg/kg lead (dry weight) is unacceptable for open water disposal. In Talford Creek, ether solubles exceeded the suggested limit for a distance of at least 900 feet downstream of the Shell outfalls while lead is in excess of the limit for more than 500 feet downstream. No limit has been suggested for PCB accumulation in sediment.

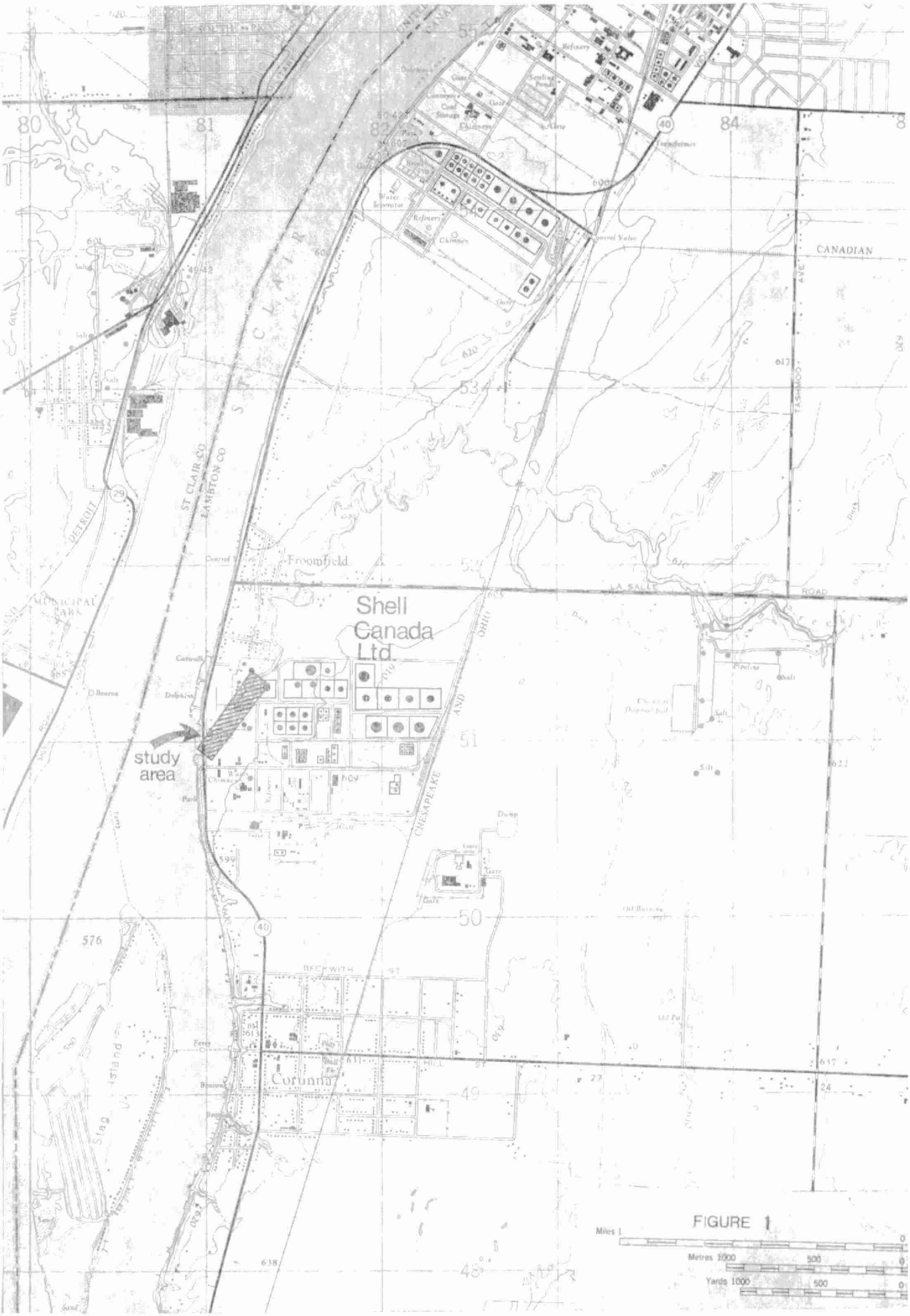
4.3 Benthic Fauna

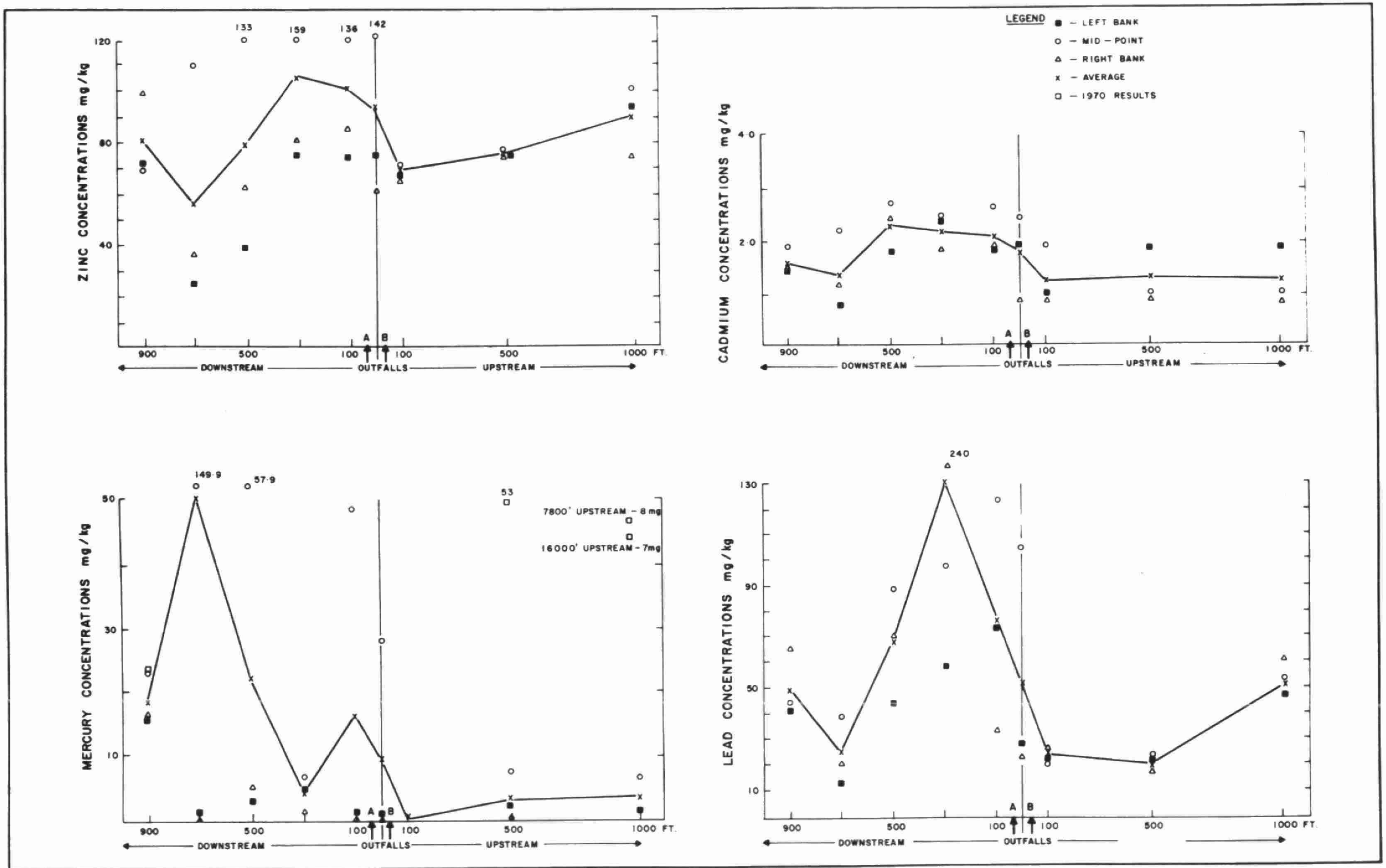
The examination of the benthic fauna of Talford Creek in January 1974 revealed the presence of only two species of sludgeworms both of which are pollution tolerant forms. These organisms exist in highly organic environments as indicated by their occurrence in such areas as the western basin of Lake Erie, Hamilton Harbour and the inner arm of the Bay of Quinte.

Limnodrilus cervix was the predominant species at all stations with the highest numbers occurring near the mouth. The numbers progressively decreased at stations nearer the Shell outfalls reflecting a more toxic environment and/or scouring of the bottom by the high volume effluent. The very low water temperatures upstream of Shell, i.e. in the range 1.05°C to 1.3°C and the limited availability of a suitable substrate contributed to very low numbers of sludgeworms being found there.

TABLE 1: Shell Canada Ltd. - Oil (Ether Solubles) Loadings to Talford Creek

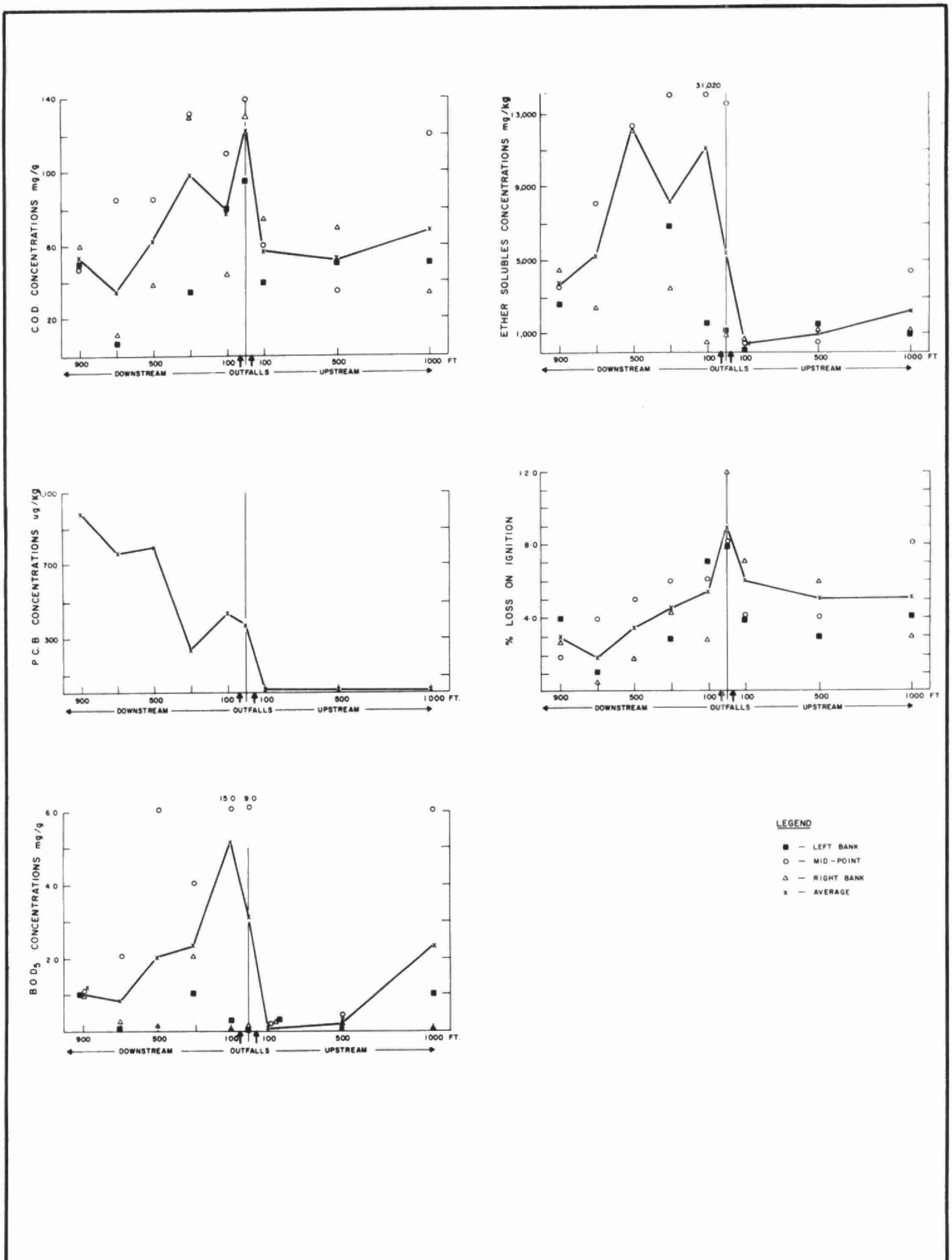
Date	Water Intake from St. Clair River lbs/day	Combined Total Effluent to Talford Creek Aug. Total Loadings lbs/day	Max. Daily Loading for Treated Outfall Only (B) lbs/day
Jan 73	800	1686	2860
Feb 73	375	1354	2443
Mar 73	714	1513	2714
Apr 73	846	958	1361
May 73	920	3030	6912
Jun 73	1072	2516	5292
Jul 73	1180	2497	5161
Aug 73	1238	2608	6124


Shell
Canada
Ltd.
study
area
ST CLAIR CO
LAMBTON CO
DETROIT
Froomfield
LA SALLE
ROAD
CANADIAN
TASHMOO AVE
CHESAPEAKE AND OHIO
BECKWITH ST
Corunna
Slag Island
FIGURE 1
Miles 1
Metres 1000
500
Yards 1000
500



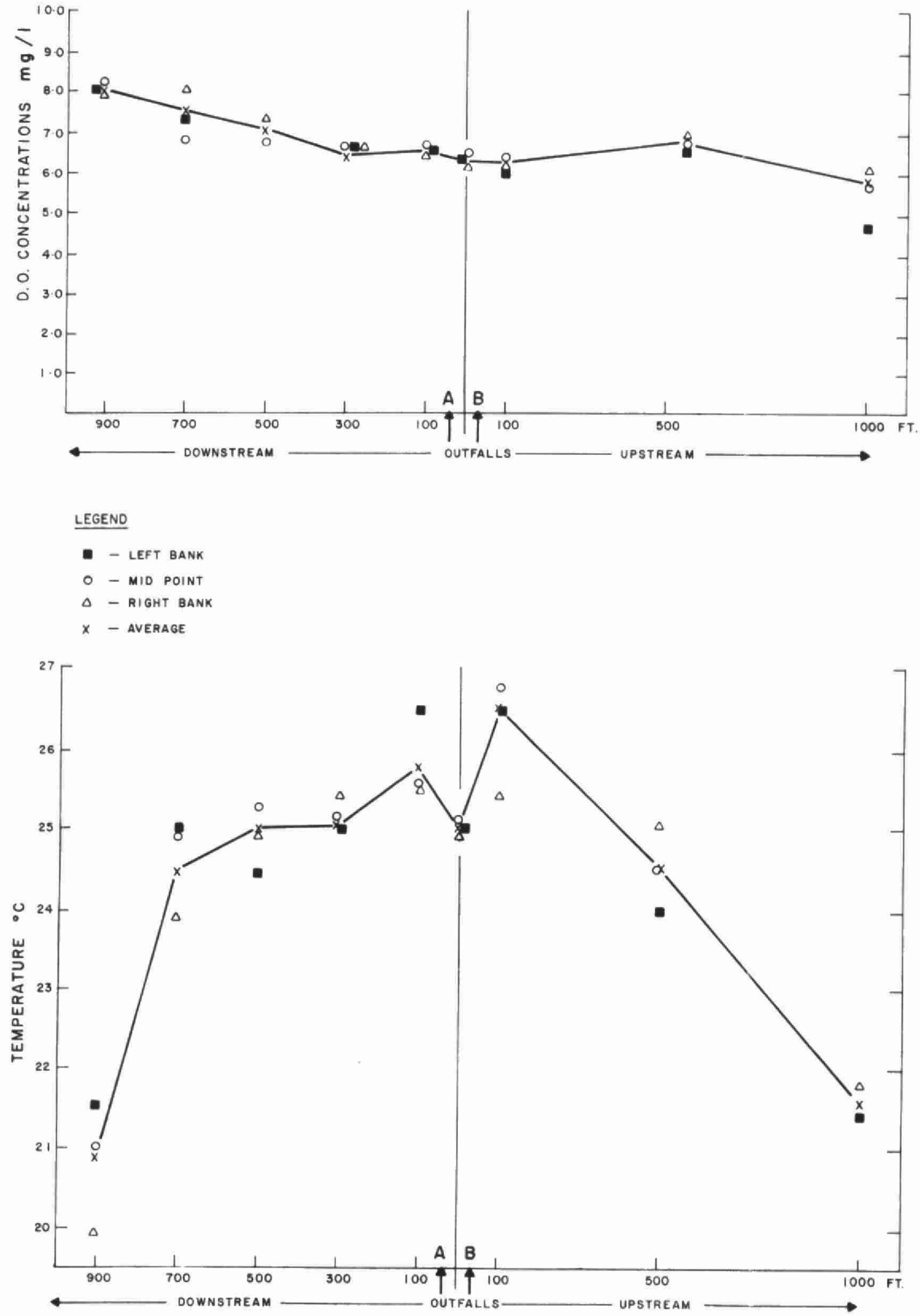
SEDIMENT ANALYSIS — TALFORD CREEK
AUGUST 7–9, 1973

FIGURE 2



SEDIMENT ANALYSIS — TALFORD CREEK
AUGUST 7 – 9, 1973

FIGURE 3



WATER ANALYSIS — TALFORD CREEK

AUGUST 7 – 9, 1973

FIGURE 4

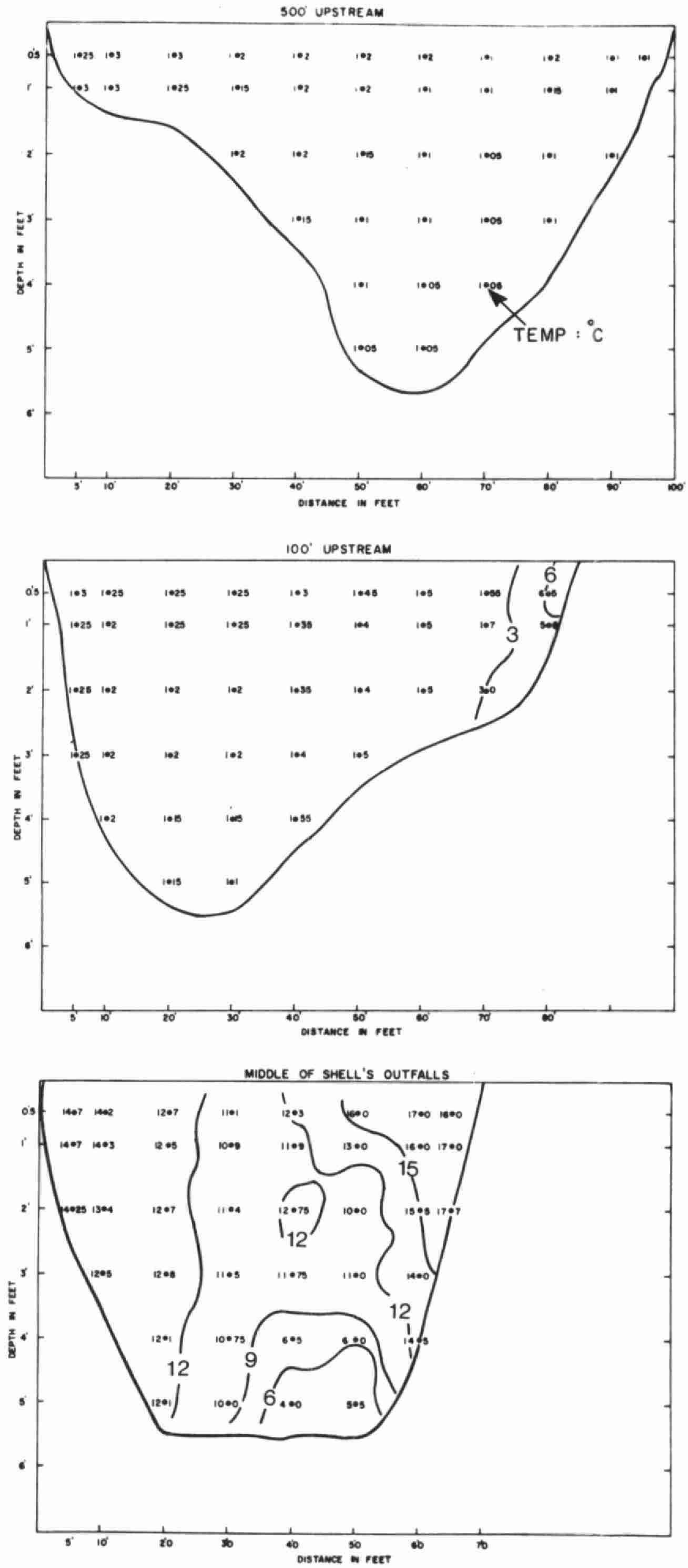


FIG. 5A TALFORD CREEK TEMPERATURE PROFILES
JANUARY 30, 1974

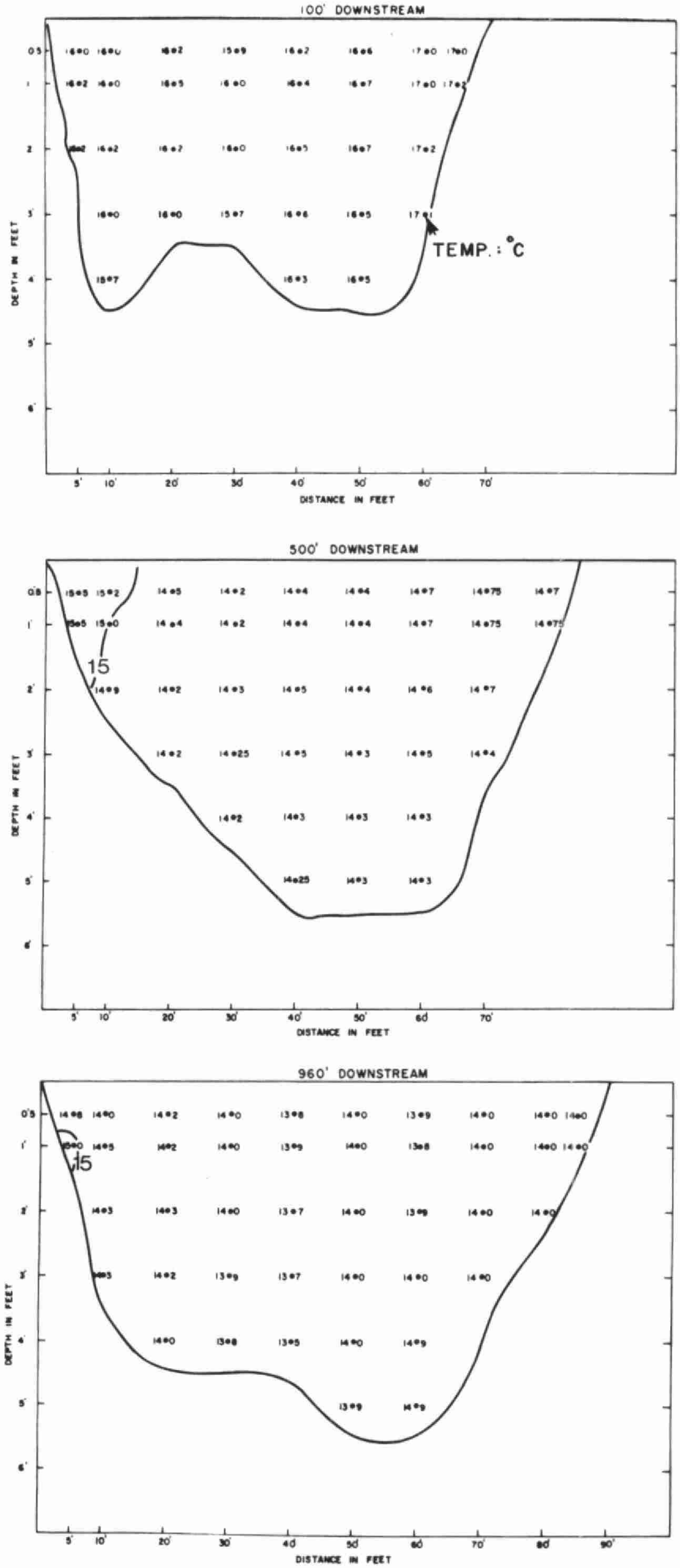


FIG. 5B TALFORD CREEK TEMPERATURE PROFILES
JANUARY 30, 1974

Date Due
